



Rebleed Studies: Preliminary Results

Lisa Brasche, Rick Lopez, and
Austin Brasche

Center for Nondestructive
Evaluation

Iowa State University

lbrasche@cnde.iastate.edu

(515) 294-5227



Funded by the Federal Aviation Administration



- Provide engineering data to support decisions regarding the safe application and relevant use of FPI
- Includes data to support changes in specifications
- Generate tools for use by airlines and OEMs that improve FPI processes
- Strong industry team with extensive experience





- Define areas where engineering data is deficient due to:
 - Change in process or materials
 - Change in applications
 - Data not available in the public domain
- Perform studies to provide quantitative assessment of performance
 - Indication luminance measurements
 - Digital recording of UV-A indication
 - Probability of detection
- Complete study using either lab or shop facilities
- Distribute results through use of web
- Support changes to industry specifications as warranted
- Utilize results to update/create guidance materials

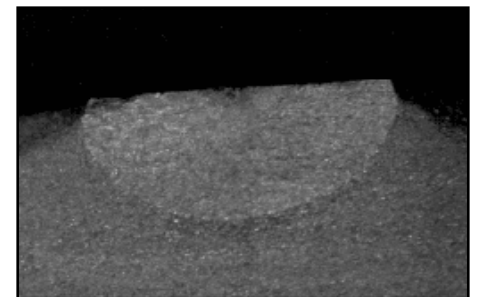
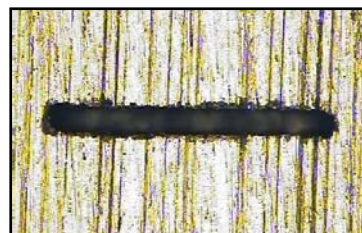
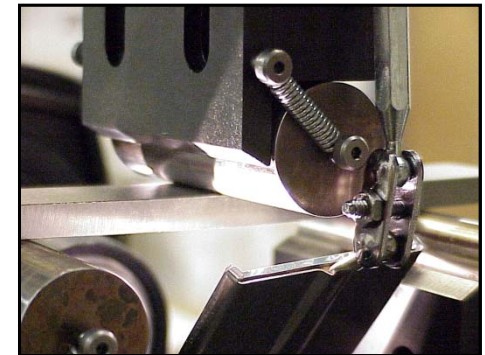


- Used rigid fixturing to assure repeatability with transportability for brightness measurements
- Photo Research PR-880 Photometer used to record indication brightness in ft-Lamberts





- Materials:
 - Titanium 6Al-4V
 - Inconel 718
 - Aluminum 6061-T6511
- EDM notches used as starter defects
- Three point bending at 0.1 R-ratio gave 2.5:1 aspect ratio
- Lengths from 20 to 180 mils, centered at 80 mils





3.4.12.12. Indications shall be investigated to verify their nature whether relevant, non-relevant, or false. Interfering fluorescent background, relevant or questionable indications may be evaluated as follows:

NOTE: This procedure may only be performed twice for any given original indication or area.

3.4.12.12. 1 Lightly dampen a clean soft brush or cotton swab with clean solvent (e.g., Isopropyl Alcohol, Acetone, or Methyl Ethyl Ketone (where locally approved) etc.).

NOTE: Halogenated solvents shall not be used on titanium alloys.

3.4.12.12.2 Remove any excessive solvent from the brush or cotton swab applicator. Under black light illumination, lightly wipe the area in question with the dampened brush or cotton swab. Do not permit solvent to flood or run over the surface of the part. Allow the solvent to evaporate from the surface of the part.

3.4.12.12.3 If an indication reappears immediately and is rejectable to the acceptance criteria, the component may be rejected. If an indication does not appear immediately, apply dry or nonaqueous developer to the area being evaluated. Allow at least 10 minutes for the indication to develop. If no indication reappears, the original indication is considered false. All indications found shall be evaluated to the specified acceptance criteria.

3.4.12.12.4 If necessary, magnification and/or white light may be used to determine the type of discontinuity.



- What effect does repeating the rebleed process have on detection?
- Comparison of acetone and isopropyl alcohol as wiping agent
- Comparison of acetone and alcohol based NAWD
- Comparison of cotton swab to wipes
- Comparison of Level 4 PE to Level 3 WW

Rebleed Study Outline



Penetrant	Developer Form	Removal method	NAWD
Level 4 PE Level 3 WW	Form A, dip/drag 2 hour dwell time	Acetone swab - normal Isopropyl swab – normal Acetone swab – fully soaked Isopropyl swab – fully soaked Acetone wipe Isopropyl wipe	Form D acetone based Form D alcohol based

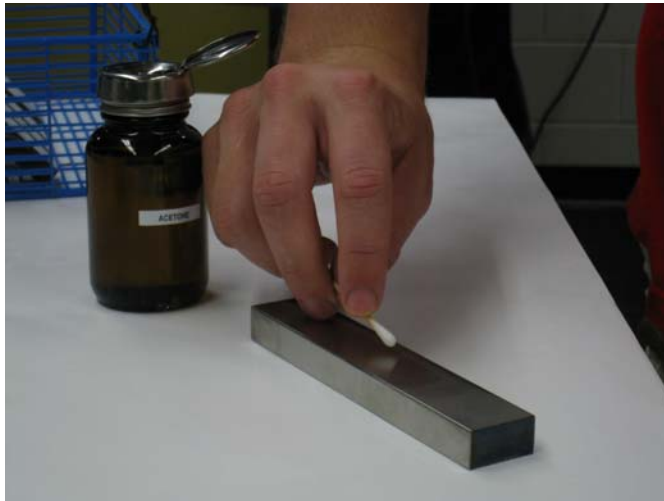


- Penetrant Dwell Time: 20 minutes
 - Level 4
 - Water Rinse 90 sec.
 - Place in Emulsifier for 2 minutes agitate every 15 seconds
 - Water Rinse 90 sec.
 - Level 3
 - Water Rinse 90 sec.
- Dry samples at 160F for 8 minutes, cool to touch
- Dip/drag application of Form A developer
- Measure brightness and capture UVA images at 10 minutes and 2 hours (min and max times in AMS 2647)
- Use swab or wipe
- Apply NAWD, dwell 10 minutes, measure brightness and capture UVA image
- Repeat swab/wipe and NAWD process for second and third time
- Rinse and acetone clean

Rebleed Study Process Steps



Swab wipe with either acetone or isopropyl alcohol



Prepackaged wipes with either acetone or isopropyl alcohol





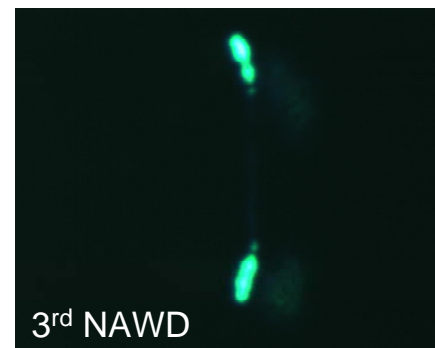
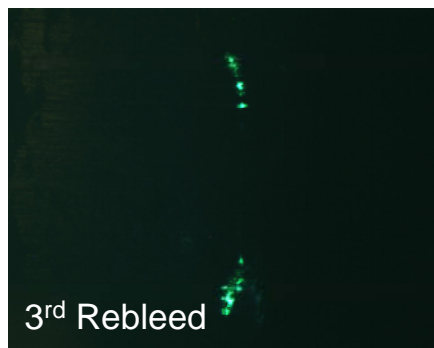
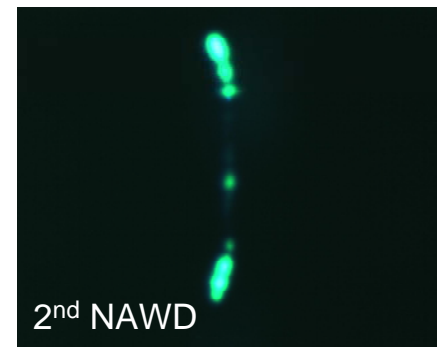
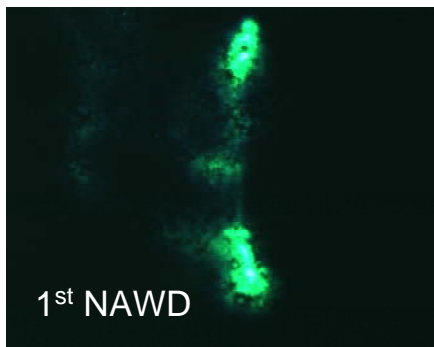
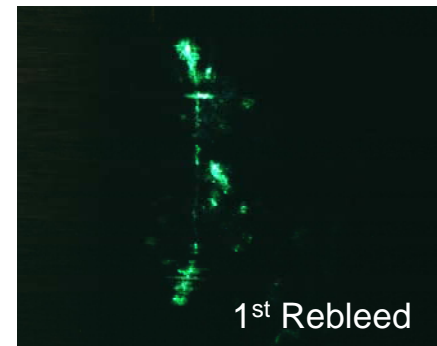
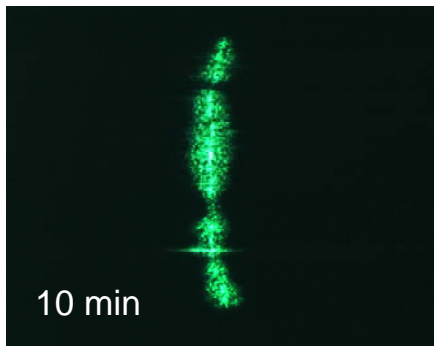
- Measured brightness and captured UVA image at each step
- Eight measurements per run





Crack length = 88 mils

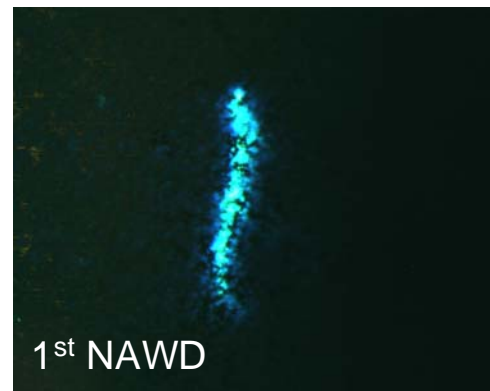
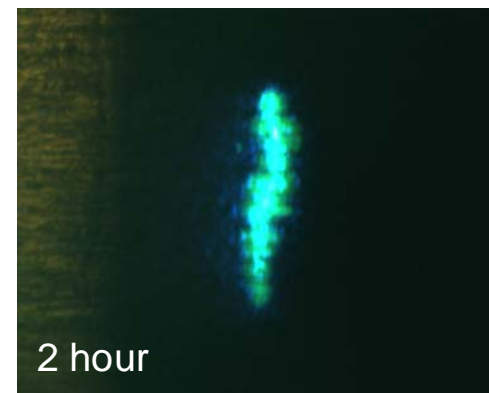
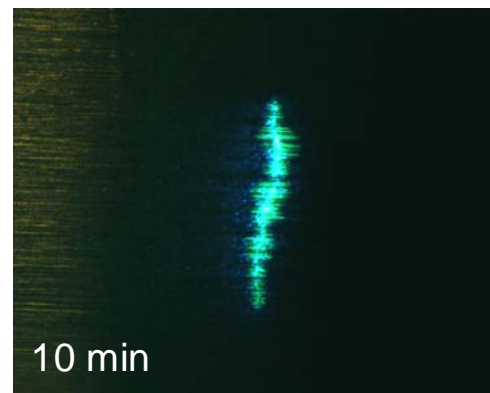
02-084-Baseline 2





Crack length = 62 mils

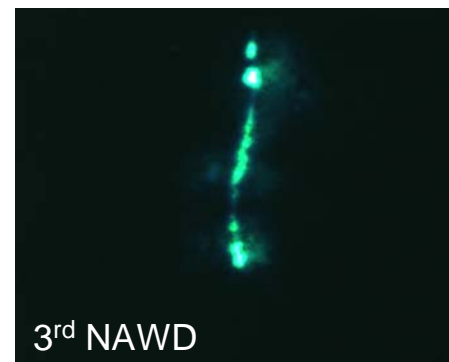
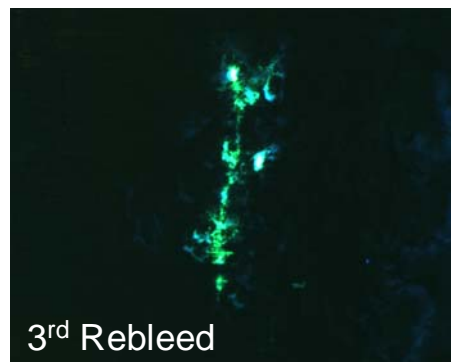
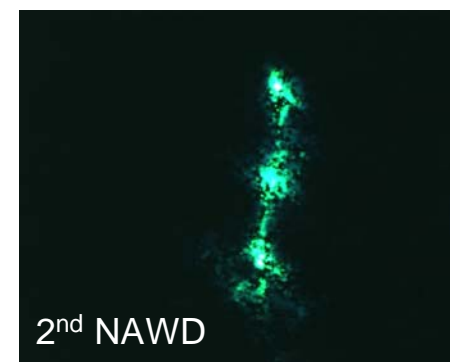
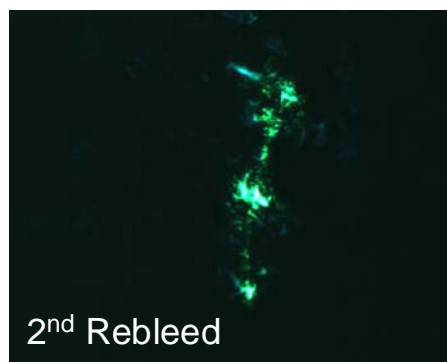
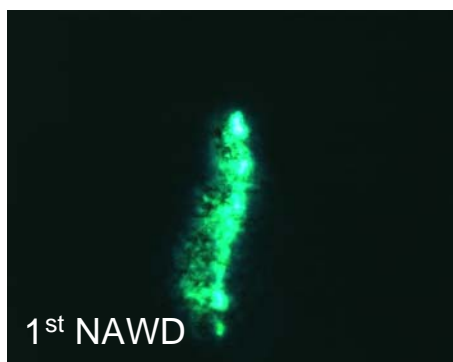
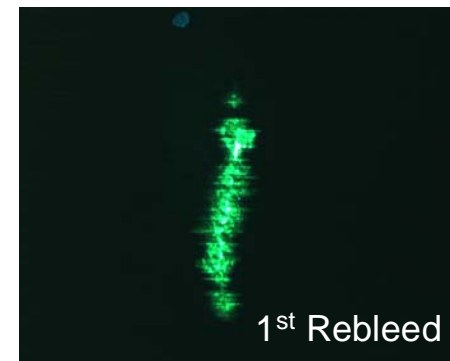
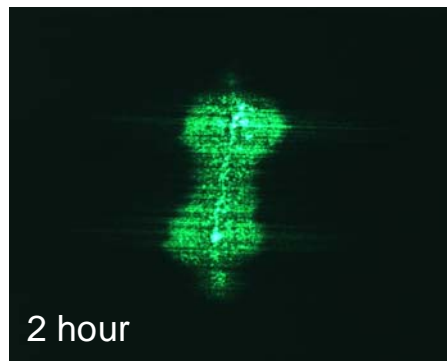
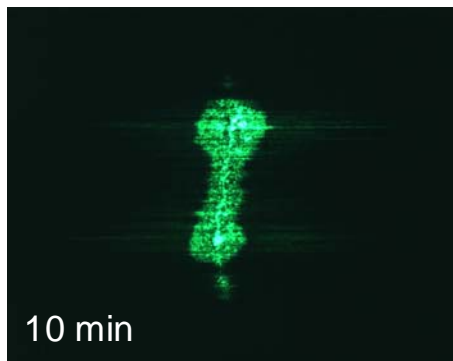
02-423-Baseline 3





Crack length = 78 mils

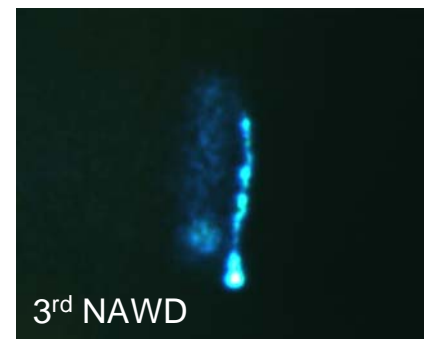
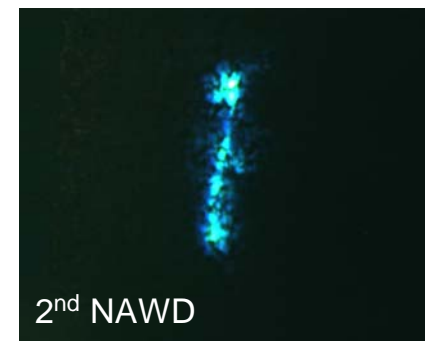
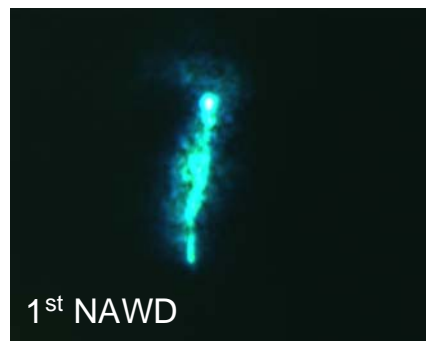
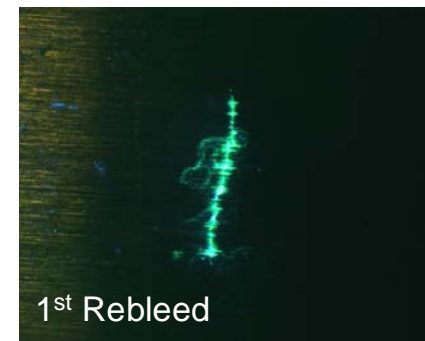
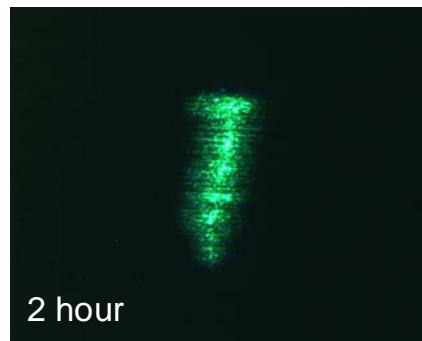
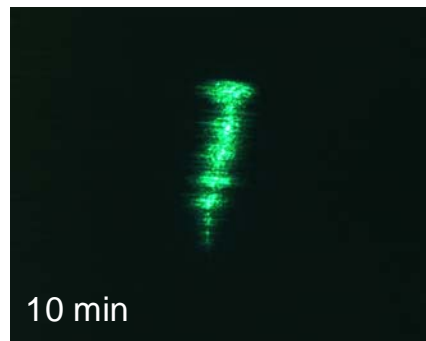
02-439-Baseline 1





Crack length = 62 mils

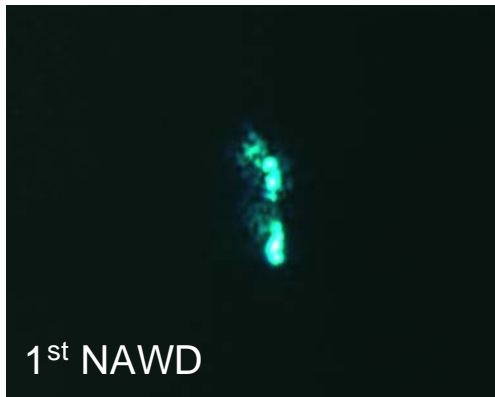
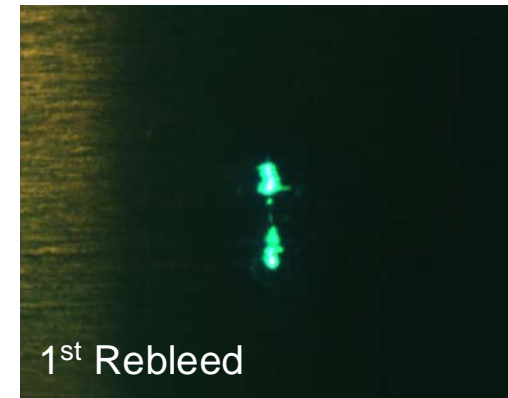
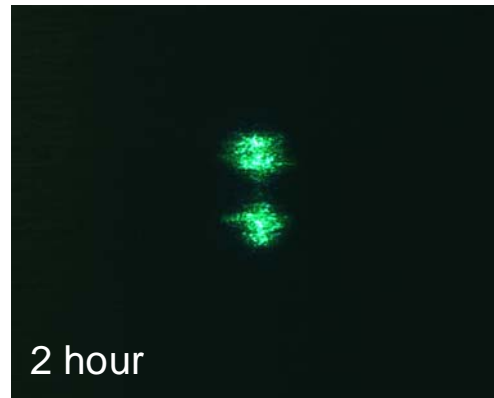
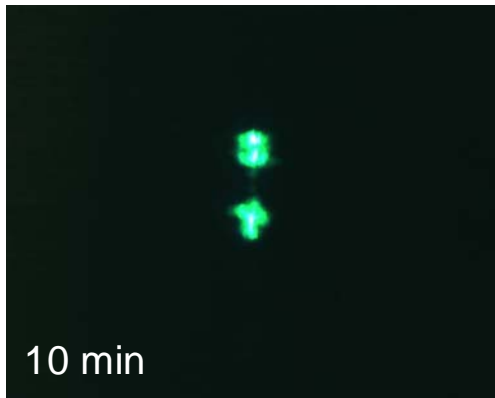
02-441-Baseline 2





Crack length = 33 mils

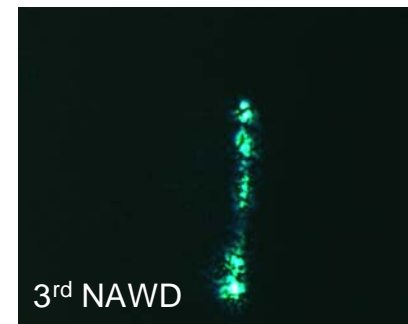
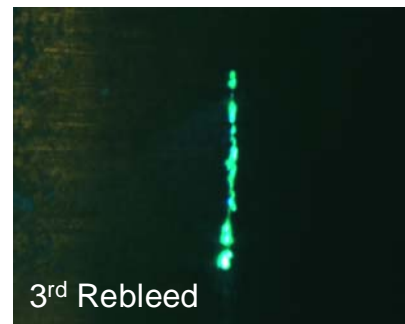
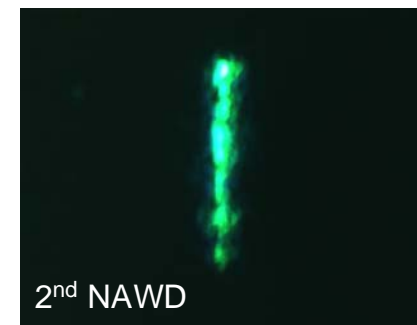
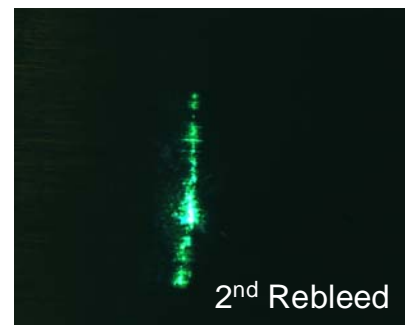
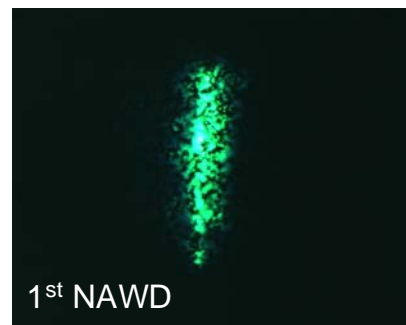
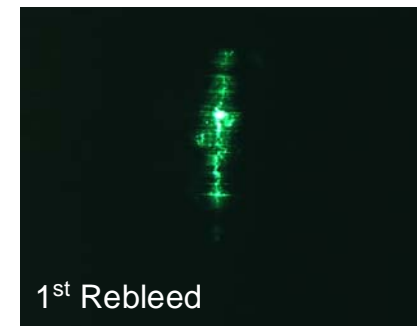
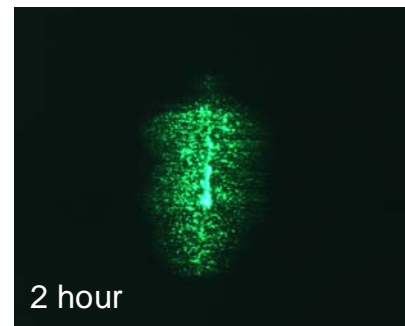
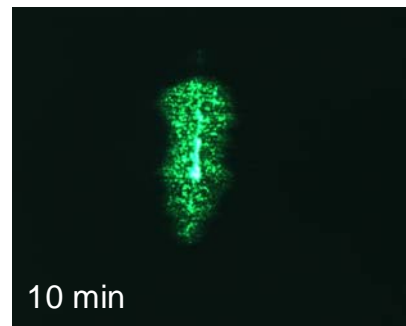
02-456-Baseline 3

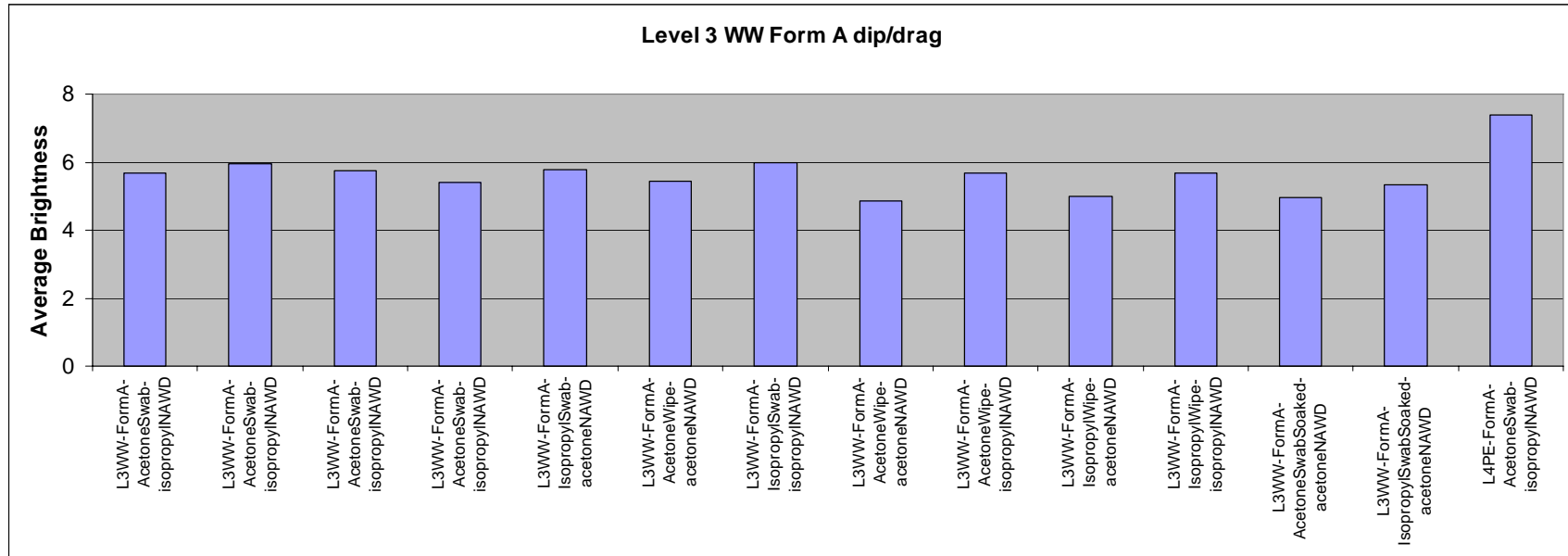
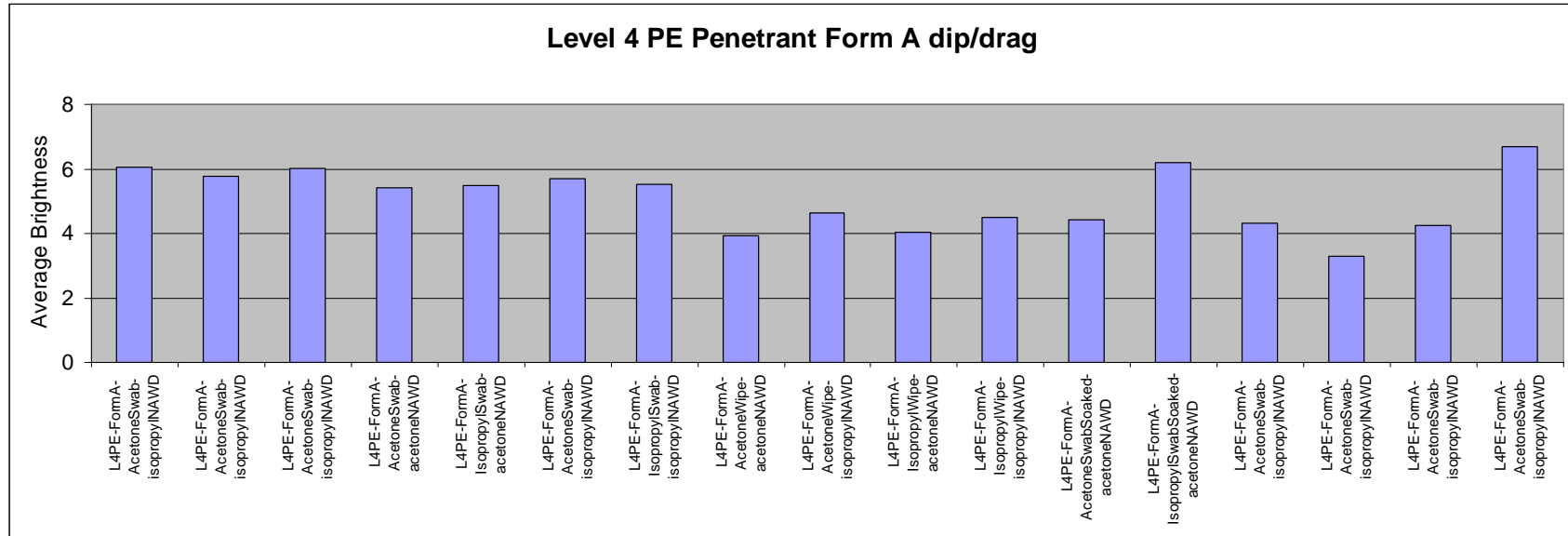




Crack length = 69 mils

02-475-Baseline 3







- 13 runs using Level 4 PE and 13 runs using Level 3 WW
 - Total number of opportunities: 78 (6 cracks times 13 runs)
- Level 4 PE
 - Rebleed 1 – all cracks measureable
 - Rebleed 2 – one of 78 not measureable
 - Rebleed 3 – eleven of 78 not measureable
- Level 3 WW
 - Rebleed 1 – all cracks measureable
 - Rebleed 2 – one of 78 not measureable
 - Rebleed 3 – three of 78 not measureable



- 13 runs using Level 4 PE and 13 runs using Level 3 WW
 - Total number of opportunities: 78 (6 cracks times 13 runs)
- Even though response may be measured with photometer that does not equate to detection by an inspector
- Level 4 PE
 - Rebleed 1 – 40 cracks have brightness less than 2.5
 - Rebleed 2 – 56 cracks have brightness less than 2.5
 - Rebleed 3 – 70 cracks have brightness less than 2.5
- Level 3 WW
 - Rebleed 1 – 26 cracks have brightness less than 2.5
 - Rebleed 2 – 49 cracks have brightness less than 2.5
 - Rebleed 3 – 58 cracks have brightness less than 2.5



- Additional data analysis planned
- Repeat runs are planned to verify trends
- Initial data indicates rebleed steps have significant impact on brightness
- Given results, POD study may be warranted